

Morphological studies of honey bees in the northern wooded steppe zone of the Republic of Bashkortostan

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Abstract. The article presents assessment results for the preservation of European dark honey bees in the northern wooded steppe zone of the Republic of Bashkortostan, which is an integral structure in the honey bee *Apis mellifera mellifera* population of northern Bashkortostan. Bee farms of 24 settlements in Askinskiy, Arkhangelskiy, Baltachevskiy, Karaidelskiy and Yanaulskiy districts show the persistence of taxonomically pure bees, which stands for 73 % of the samples. During the bee-breed identification, the most volatile parameters were determined (the length the rostrum, the length and width of the right hemelytron, the cubital index) that are greatly influenced by the hybridization processes. The presence of registered pure-breed bee colonies speaks of the biopotential of the European dark bee population in the farms of the given region, which will allow to create pedigree breeding units and pure breeding zones for native bees in the future.

1 Introduction

The breeding work on bee farms of any levels nowadays is mostly connected with increasing the productivity of bee colonies by producing and using hybrid bees. The scientific validity of this method is beyond questioning, as well as the use of the heterosis effect that allows to significantly increase the productivity of colonies if good cross-breed combinations are found. The success of such activities depends on access to biologically pure materials [1–4].

Konusova O. L. et al pointed out that the main goal of bee-keeping is the increase of productivity of colonies, which is mainly characterized by winter hardiness, melliferous capacity, and the productivity of the queens. To achieve this goal, it is crucial to have a biological and economic assessment of bees, finding the pure breed colonies, and producing highly-fertile queens [5].

The importance of preserving pure-breed bees was noted by V.A. Gubin, who wrote in one of his works (1984): “under the conditions of uncontrolled mating at bee farms surrounded by colonies of different or unknown breeds, which is often the case, the question of practical usage of the heterosis effect is not easy and obvious” [6]. The author also claimed that it must be kept in mind that cross-breed hybrid may often have ‘inferior parameters’ [6].

At the same time, N.V. Ostroverkhova et al claim that the genetic diversity typical of natural populations is one of the most important conditions for the sustainable

development of bee farming [7]. Currently, the global loss of diversity and numbers of bees is evident all over the world, therefore one of the key objectives of bee-keeping must be the preservation of native breeds and populations of the honey bee.

Within the Republic of Bashkortostan (RB), according to some researchers, several populations are preserved in Tatyshly, Aksino and Baltachevo apart from the Burzyan population, which all put together can comprise the north Bashkir population of *Apis mellifera mellifera* [8, 9]. Taking into consideration that the processes of global hybridization and pure-breed population disappearance take place in all of the regions, the research aimed at preservation monitoring is of the highest scientific and practical significance.

2 Materials and Methods

The study objects are the imagos of honey bees – workers (Fig. 1).



Fig. 1. Worker honey bee specimen

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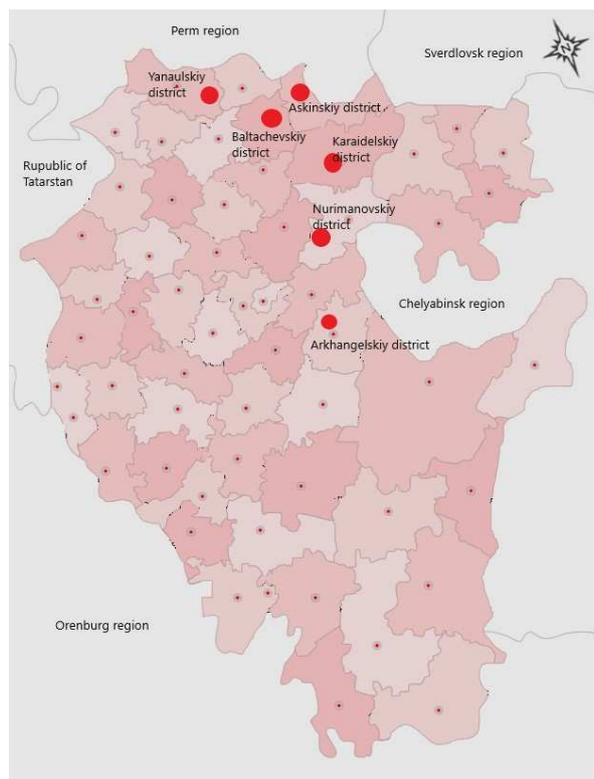


Fig. 2. The map of Bashkortostan (sampling locations are marked in red)

The field research (2010–2018) was carried out in bee farms in administrative districts of the northern

wooded steppe zone of the Republic of Bashkortostan: Askinskiy, Arkhangelskiy, Baltachevskiy, Karaidelskiy, Nurimanovskiy and Yanaulskiy (Fig. 2). The total of bee colonies (farms/settlements) was 1300 per 28 settlements. We used a standard morphometric method for the assessment of worker bees.

The data obtained were compared with the established European standards from the literature [10]. To analyze the consolidated data, we used the *Statistica* software version 6.1.

3 Results and Discussion

The results of the morphological study of worker honey bees (*Apis mellifera*) from the northern wooded steppe zone of Bashkortostan are presented in Table 1.

In Askinskiy district, samples were taken from farms in five settlements: Askino (40 farms/settlement), Kuchanovo (60 farms/settlement), Matala (50 farms/settlement), Kayumovo (50 farms/settlement) and Stepanovka (50 farms/settlement). The total of colonies is 250. The bees complied with the standard of *Apis mellifera mellifera* in almost all parameters. For example, the average rostrum lengths in mm were: (6.19±0.14 (Askino), 6.16±0.14 (Kuchanovo), 6.22±0.09 (Matala), 6.23±0.09 (Kayumovo and Stepanovka)) did not exceed or fall under the standard limits (6.0–6.4 mm). The same situation was with the upper and lower *limit* (6.00±6.40 (Askino and Kuchanovo), 6.15±6.40 (Matala and Kayumovo), 6.10±6.40 (Stepanovka)).

Table 1. The results of the morphological study of *Apis mellifera* from the farms in the northern wooded steppe zone of Bashkortostan

Parameter	*Indicator	District and morphological measurement results					
		Askinskiy	Arkhangelskiy	Baltachevskiy	Karaidelskiy	Nurimanovskiy	Yanaulskiy
Length of rostrum, mm	<i>M±m</i>	6.2±0.1	6.2±0.1	6.2±0.1	6.2±0.1	6.7±0.3	6.2±0.1
	<i>lim</i>	6.0–6.4	6.0–6.4	5.9–6.4	6.0–6.4	6.3–7.1	6.0–6.4
Length of right hemelytron, mm	<i>M±m</i>	9.3±0.1	9.3±0.1	9.3±0.1	9.3±0.2	8.9±0.1	9.4±0.2
	<i>lim</i>	9.0–9.6	9.0–10.0	9.2–10.0	9.0–10.0	8.7–10.0	9.2–10.1
Width of right hemelytron, mm	<i>M±m</i>	3.1±0.1	3.2±0.1	3.1±0.1	3.2±0.1	3.1±0.1	3.1±0.2
	<i>lim</i>	3.0–3.5	3.0–3.5	3.0–3.5	3.0–3.5	2.7–3.5	3.0–3.5
Cubital index, %	<i>M±m</i>	63.4±0.1	63.4±0.9	63.5±0.8	63.5±0.8	59.6±2.8	63.6±0.9
	<i>lim</i>	60.0–65.0	60.0–65.0	60.0–65.0	61.4–65.0	53.5–65.4	60.0–65.0
Length of 4th dorsal plate, mm	<i>M±m</i>	2.3±0.1	2.3±0.1	2.4±0.1	2.3±0.1	2.3±0.1	2.4±0.1
	<i>lim</i>	2.3–2.5	2.3–2.5	2.3–2.5	2.3–2.5	2.1–2.6	2.3–2.6
Width of 4th dorsal plate, mm	<i>M±m</i>	4.9±0.1	4.8±0.1	4.8±0.1	4.8±0.1	4.8±0.1	4.8±0.1
	<i>lim</i>	4.8–4.9	4.8–4.9	4.8–5.0	4.8–5.0	4.6–4.9	4.8–5.0
Length of 4th sternum, mm	<i>M±m</i>	3.1±0.1	3.1±0.1	3.1±0.1	3.1±0.1	3.1±0.1	3.1±0.1
	<i>lim</i>	3.1–3.2	3.1–3.3	3.0–3.2	3.0–3.2	2.9–3.2	3.0–3.2
Width of 4th sternum, mm	<i>M±m</i>	4.8±0.1	4.8±0.1	4.8±0.1	4.8±0.1	3.9±0.1	4.8±0.1
	<i>lim</i>	4.8–4.9	4.8–4.9	4.7–4.9	4.6–4.9	3.9–4.1	4.7–4.9
Length of wax plate, mm	<i>M±m</i>	2.6±0.1	2.6±0.1	2.6±0.1	2.6±0.1	2.5±0.1	2.6±0.1
	<i>lim</i>	2.5–2.7	2.5–2.7	2.5–2.7	2.5–2.7	2.4–2.8	2.5–2.7
Width of wax plate, mm	<i>M±m</i>	1.6±0.1	1.6±0.1	1.6±0.1	1.6±0.1	1.5±0.1	1.6±0.0
	<i>lim</i>	1.5–1.6	1.5–1.7	1.5–1.6	1.5–1.7	1.4–1.7	1.5–1.7
Tarsal index, %	<i>M±m</i>	53.1±0.7	53.1±0.7	53.1±0.7	53.1±0.9	53.9±2.7	53.4±0.8
	<i>lim</i>	52.4–54.6	52.4–54.6	50.4–54.6	50.4–54.6	49.3–59.6	50.7–55.0

*Note. The table shows values rounded to a tenth, and further in the text values are rounded up to a hundredth.

The same situation was with the length and width of the hemelytron. The standard values for the European dark bee are 9–10 mm (length), 3–3.5 mm (width). The

average lengths obtained are 9.32±0.06 (Askino), 9.32±0.05 (Kuchanovo), 9.31±0.06 (Matala), 9.31±0.06 (Kayumovo), 9.31±0.05 (Stepanovka); the *limit* values:

9.30–9.60 (Askino, Kuchanovo, and Stepanovka), *limit* 9.00–9.50 mm (Matala and Kayumovo). The average values for width are as follows: 3.13±0.12 (Askino), 3.12±0.11 (Kuchanovo), 3.16±0.09 (Matala), 3.15±0.09 (Kayumovo) and 3.14±0.11 (Stepanovka). The cubital index also complied with the standard – 60–65 %. Its averages were as follows: 63.42±0.98 (Askino), 63.52±0.91 (Kuchanovo), 63.51±0.85 (Matala), 63.51±0.85 (Kayumovo) and 63.46±0.99 (Stepanovka). The next parameter is the dorsal plate. Its parameters complied with the European dark bee standard (length of 2.30–2.60 mm, width of 4.80–5.00 mm). The average dorsal plate length and width values (in mm) were as follows: 2.37±0.08 and 4.86±0.05 (Askino), 2.36±0.08, 4.86±0.04 (Kuchanovo), 2.36±0.07 and 4.86±0.04 (Matala), 2.36±0.07 and 4.85±0.05 (Kayumovo) and 2.36±0.770, 4.86±0.05 (Stepanovka). The *limit* values for length and width (in mm) also remained within the standard: 2.36–2.55 and 4.82–4.96 (Askino); 2.30–2.55, 4.82–4.96 (Kuchanovo); 2.30–2.50, 4.82–4.96 (Matala); 2.30–2.50 and 4.81–4.96 (Kayumovo) and 2.30–2.55, 4.82–4.96 (Stepanovka). The sternum values also complied with the standard (3–3.20 mm length, 4.75–4.90 mm width). For example, in Askino, the length was 3.14±0.06, *limit* – 3.02–3.19, and the width was 4.81±0.06, *limit* 4.75–4.90; In Kuchanovo 3.13±0.06, *limit* 3.02–3.19; and 4.81±0.05, *limit* 4.76–4.85 respectively; in Matala, 3.13±0.06, *limit* 3.02–3.18 and 4.80±0.06, *limit* 4.75–4.90; In Kayumovo, 3.15±0.06, *limit* 3.03–3.17 and 4.80±0.05, *limit* 4.75–4.90; in Stepanovka 3.16±0.01, *limit* 3.04–3.19 and 4.81±0.05 respectively. The next parameter is the wax plate (standard length of 2.45–2.70 mm and width of 1.50–1.70 mm). These values did not exceed or fall below the standard limits. The last parameter analyzed is the tarsal index. In this respect, the bees also complied with the standard for the European dark bee breed (50–55 %): in Askino, the average was 53.07±0.71 (*limit* 53.39–54.57), in Kuchanovo, 53.07±0.708 (*limit* 52.39–54.56), in Matala, 53.09±0.745 (*limit* 52.38–54.56), in Kayumovo, 53.08±0.73 (*limit* 52.40–54.56) and in Stepanovka, 53.90±0.73 (*limit* 52.52–54.57) respectively.

In Arkhangelskiy district, bees were sampled for analysis from four settlements: Terekly (50 farms/settlement), Aytmembetovo (50 farms/settlement), Askino (50 farms/settlement) and Bakaldinskoye (50 farms/settlement). The results show the presence of the European dark bee breed. We got the following data on the average and *limit* lengths of rostrum (in mm): Terekly 6.22±0.06 (*limit* 6.10–6.30); Aytmembetovo 6.21–0.07 (*limit* 6.00–6.30), Askino 6.21–0.07 (*limit* 6.00–6.40), Bakaldinskoye 6.20±0.14 (*limit* 6.00–6.40). The averages of the cubital index in % also complied with the standard: 63.46±0.93 (Terekly), 63.45±0.93 (Aytmembetovo), 63.38±0.89 (Askino), 63.65±0.98 (Bakaldinskoye). The same situation is observed for other parameters as well.

In Baltachevskiy district, the sampling was carried out on bee farms in six settlements: Starobaltachevo (35 farms/settlement), Kundashly (45 farms/settlement), Mishkino (30 farms/settlement), Seytyakovo

(30 farms/settlement), Norkino (30 farms/settlement) and Annovka (30 farms/settlement). The bees complied with the European dark bee standard in all parameters. On the farms of Seytyakovo, there were bees whose parameters exceeded the *limit* values of the standard in rostrum length (standard of 6–6.4 mm). Despite this, the bees from this settlement can be deemed as European dark bees because many authors claim that the rostrum length standard for this breed is 5.95–5.50 mm, and all the other parameters were in compliance with the standard.

In Karaidelskiy district, the sampling was carried out on bee farms in the following settlements: Baykirashevo (60 farms/settlement), Karaidel (50 farms/settlement), Suleymanovo (40 farms/settlement) and Yavgildino (50 farms/settlement). The average rostrum length (mm) is as follows: 6.25±0.09 (Baykirashevo), 6.24±0.08 (Karaidel), 6.23±0.07 (Suleymanovo), 6.24±0.08 (Yavgildino). The situation with the length and width of hemelytron is identical. The average length (mm) is as follows: 9.32±0.02 (Baykirashevo), 9.35±0.16 (Karaidel), 9.36±0.15 (Suleymanovo), 9.34±0.12 (Yavgildino); and the *limit* is 9.00–10.00 (Baykirashevo and Karaidel), 9.10–9.90 (Suleymanovo) and 9.30–10.00 (Yavgildino). The average hemelytron width (mm) is as follows: 3.17±0.12 (Baykirashevo), 3.17±0.11 (Karaidel), 3.18±0.11 (Suleymanovo), 3.18±0.12 (Yavgildino).

The cubital index also complied with the standard (in mm): 63.46±0.91 (Baykirashevo), 63.54±0.88 (Karaidel), 63.48±0.75 (Suleymanovo), 63.50±0.90 (Yavgildino). The *limit* values of the index also complied with the standard. The dorsal plate parameters were fully compliant with the European dark bee standard (in mm): 2.37±0.08 and 4.87±0.05 (Baykirashevo), 2.36±0.08, 4.87±0.05 (Karaidel), 2.39±0.06 and 4.89±0.06 (Suleymanovo), 2.39±0.06 and 4.87±0.05 (Yavgildino). The situation with the sternum and the wax plate was identical. For example, wax plate parameters (in mm): Baykirashevo: length 3.13±0.07, *limit* – 3.02–3.19, width 4.79±0.05, *limit* 4.75–4.90; Karaidel: 3.14±0.06, *limit* 3.02–3.19; and 4.80±0.05, *limit* 4.75–4.90; Suleymanovo: 3.11±0.074, *limit* 3.00–3.19; and 4.82±0.05, *limit* 4.75–4.90; Yavgildino: 3.14±0.06, *limit* 3.00–3.19; and 4.80±0.055, *limit* 4.75–4.90 respectively. The tarsal index of the bees also complies with the breed standard: in Bayrikashevo, the average was 53.22±0.77 % (*limit* 52.52–54.57), in Karaidel 53.15±0.72 % (*limit* 52.52–54.43), in Suleymanovo 53.14±0.96 % (*limit* 50.36–54.43), and in Yavgildino 53.09±0.92 % (*limit* 51.55–54.57) respectively.

In Nurimanoskiy district, samples were taken from 250 farms from four settlements: Nikolskoye, Novokulevo, Urman and Novoisayevo. In this district, hybridization processes were detected. For example, the rostrum lengths were as follows (in mm): 6.73±0.22, with the *limit* value of 6.50–7.00 (Nikolskoye), 6.71±0.26, with the *limit* of 6.30–7.10 (Novokulevo), 6.74±0.25 (*limit* 6.30–7.00) (Urman), 6.68±0.26 *limit* 6.40–7.10) (Novoisayevo). As we can see, the average values exceed the standard of *Apis mellifera mellifera*.

However, the lower *limit* values for bees from Novokulevo, Novoisayevo, and Urman comply with the standard of the European dark bee, while the upper limit is beyond its requirements. In Nikolskoye, the *limit* values of bees are not compliant with the breed standard. The hemelytron length and width values in two of the farms did not comply with the breed standard (in mm): Novokulevo (8.99±0.10) and Novoisayevo (8.98±0.08), and in two others, they did: Nikolskoye (9.00±0.09) and Urman (9.02±0.17). The average hemelytron width were in compliance with the European dark bee standard (3.13±0.15 –in Nikolskoye, 3.14±0.12 in Novokulevo, 3.13±0.15 in Urman, 3.17±0.12 in Novoisayevo). The situation with the cubital index was identical. For instance, the averages exceeded the standard requirements (in %): 59.71±2.74 (Nikolskoye), 59.80±2.72 (Novokulevo), 59.18±2.92 (Urman), 59.89±2.98 (Novoisayevo). The results of dorsal plate measurement are also controversial. Here, the average values for bees from three farms were compliant with the standard (in mm): Nikolskoye – 2.31±0.09; Novokulevo – 2.30±0.07; Urman – 2.31±0.08. In Novoisayevo, the dorsal plate length was below the standard for the European dark bee: 2.28±0.052. The *limit* values for dorsal plate length were also controversial: the lower *limit* value was always below the standard: Nikolskoye – 2.16–2.65 mm; Novokulevo – 2.16–2.55 mm; Urman – 2.10–2.55 mm; Novoisayevo – 2.21–2.40 mm, and the upper one was in compliance with the breed standard. Let us look at the dorsal plate width. In Novoisayevo, the average value and the lower *limit* were below the standard: 4.79±0.08 mm and 4.65–4.96 mm respectively. In the rest of the settlement, the average values complied with the established standard (in mm): Nikolskoye – 4.81±0.08, Novokulevo 4.81±0.08, Urman – 4.81±0.08. The average sternum lengths complied with the *Apis mellifera mellifera* (in mm): Nikolskoye – 3.10±0.08; Novokulevo – 3.11±0.08; Urman – 3.10±0.08; Novoisayevo – 3.11±0.083. The *limit* values were compliant in one farm only: Nikolskoye – 3.00–3.20 mm. On other farms, the lower *limit* did not comply with the standard: Novokulevo – 2.99–3.20 mm, Urman – 2.99–3.22 mm, Novoisayevo – 2.99–3.21 mm. The sternum width did not comply with the standard at all. The results of wax plate measurement were also controversial. With the standard range of 1.50–1.70 mm, we got the following data: Nikolskoye (1.54±0.08), Novokulevo (1.54±0.07), Urman (1.54±0.07), Novoisayevo (1.56±0.07). The analysis of *limit* values for the wax plate showed that the lower limits were below the standard, while the upper limits complied with it, except for the bee farm in Nikolskoye: Nikolskoye (1.41–1.72 mm), Novokulevo (1.39–1.67 mm), Urman (1.40–1.65 mm), Novoisayevo (1.43–1.66 mm). The results for the wax plate width were identical. The tarsal index averages comply with the standard, but its *limit* values showed the presence of a different breed, i.e. the lower and the upper values were outside the standard

requirements: 49.52–59.02 %, 49.52–59.59 %, 49.51–59.59, 49.27–58.82 %.

In Yanaulskiy district, the sampling was carried out in the following settlements: Bayguzino, Isanbayevo, Yambayevo, Akhtiyal, and Sandugach. The total of colonies is 200. The bees complied with the breed standard in all parameters. The average rostrum lengths (in mm) is as follows: Bayguzino – 6.16±0.16; Isanbayevo – 6.27±0.08; Yambayevo – 6.26±0.07; Akhtiyal – 6.25±0.12; Sandugach – 6.27±0.07. The hemelytron length averages were within the following ranges (in mm): 9.44±0.24 (Bayguzino), 9.44±0.23 (Isanbayevo), 9.41±0.17 (Yambayevo), 9.46±0.25 (Akhtiyal), 9.43±0.21 (Sandugach). The hemelytron width averages (in mm) were as follows: 3.19±0.18 (Bayguzino), 3.20±0.13 (Isanbayevo), 3.18±0.17 (Yambayevo), 3.13±0.15 (Akhtiyal) and 3.21±0.140 (Sandugach). The cubital index in %: 63.66±1.02 (Bayguzino), 63.70±0.89 (Isanbayevo), 63.69±0.79 (Yambayevo), 63.46±1.09 (Akhtiyal) and 63.68±0.82 (Sandugach). The next tested parameter is the dorsal plate. Its values fully complied with the standard of the European dark bee breed. The average length and width (in mm) were as follows: 2.37±0.08 and 4.86±0.04 (Bayguzino), 2.44±0.07, 4.90±0.06 (Isanbayevo), 2.44±0.07 and 4.90±0.06 (Yambayevo), 2.44±0.07 and 4.89±0.06 (Akhtiyal) and 2.43±0.07, 4.89±0.05 (Sandugach). The sternum (in mm): Bayguzino: length 3.14±0.06, *limit* – 3.02–3.19, width 4.81±0.06, *limit* 4.75–4.90; Isanbayevo: 3.14±0.07, *limit* 3.00–3.20; and 4.83±0.05, *limit* 4.76–4.95; Yambayevo: 3.14±0.05, *limit* 3.05–3.20; and 4.84±0.05, *limit* 4.77–4.95; Akhtiyal: 3.13±0.05, *limit* 3.02–3.19; and 4.82±0.06, *limit* 4.75–4.90; Sandugach: 3.14±0.05, *limit* 3.05–3.20 and 4.83±0.05, 4.77–4.95 respectively. The wax plate, mm: Bayguzino: 1.56±0.03 (*limit* 1.53–1.61), 2.58±0.07 (*limit* 2.50–2.70); Isanbayevo: 1.56±0.03 (*limit* 1.50–1.65), 2.59±0.07 (*limit* 2.52–2.70); Yambayevo: 1.56±0.03 (*limit* 1.54–1.65), 2.60±0.06 (*limit* 2.54–2.70); Akhtiyal: 1.55±0.025 (*limit* 1.55–1.60), 2.60±0.06 (*limit* 2.53–2.69); Sandugach: 1.57±0.03 (1.53–1.6), 2.61±0.07 (*limit* 2.50–2.70). The tarsal index in %: in Bayguzino the average was 53.07±0.72 (*limit* 52.39–54.57), in Isanbayevo 53.23±0.85 (*limit* 51.16–54.75), in Yambayevo 53.21±0.863 (*limit* 50.70–54.50), in Akhtiyal 53.10±0.80 (*limit* 51.00–53.55), in Sandugach 54.22±0.72 (*limit* 52.10–54.20) respectively.

All in all, the European dark bee was registered on 24 bee farms in the following settlements: Askinskiy district: Askino, Kuchanovo, Matala, Kayumovo, Stepanovka; Arkhangelskiy district: Terekly, Aytmembetovo, Askino, and Bakaldinskoye; Baltachevskiy district: Starobaltachevo, Kundashly, Mishkino, Seytyakovo, Norkino, and Annovka; Karaidelskiy district: Baykirashevo, Karaidel, Suleymanovo, Yavgildino, Yanaulskiy district: Bayguzino, Isanbayevo, Yambayevo, Akhtiyal, and Sandugach. In Nurimanovskiy district, hybrid bees were detected in Nikolskoye, Kovokulevo, Urman, and Novoisayevo. It is also worth noting that during the honey bee breed identification, the most volatile

parameters were determined (the length the rostrum, the length and width of the right hemelytron, the cubital index) that are, in our opinion, greatly influenced by the hybridization processes. Among the key factors for these biological phenomena are, first of all, a lasting expansion of new breeds and breed groups, as well as the lack of scientifically grounded selection and breeding activities both on particular bee farms and in the wooded steppe zone of Bashkortostan in general. However, the presence of pure-breed bee colonies signifies that the European dark bee population in this region has certain biopotential.

4 Conclusion

It is well known that local adaptations of honey bees are unique and conservative. However, some actions that do not take into consideration the standpoint of population biology lead to the disappearance of native populations, which is true about the Bashkir honey bee population. The research carried out in the northern part of RB shows that 950 (73 %) of the bee colonies out of 1300 belong to the European dark bee, which proves the presence of the local population in the area which used to belong to the mountain and forest ecotype. We believe that the domination of the European dark bee is due to the reserve in Tatyshlinskiy district and the areas bordering the Perm region, the low amount of agricultural lands, the presence of lime trees, and the closeness of Birskiy and Askinskiy wildlife sanctuaries that perform some environmental activities.

In the future, the creation of breeding farms will allow for the replenishment of pedigree material for amateur and professional bee farms, and it will be the first step in the transition to the pure-breeding. That being said, the next step is the creation of the 'pure' breeding area in the northern part of RB, and a key instrument in this respect is setting up drone barriers with respect to the protected breed.

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